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Memorandum

To: Allen Marr
Dori Ross
GeoComp Corporation

Date: June 2, 2010

Project No.: 10989

From: Donald Cooke, P.E., P.T.O.E.
Ana Fill, P.E.

Re: Existing Origin-Destination Review and
Construction Sequencing Evaluation

EXECUTIVE SUMMARY

Vanasse Hangen Brustlin, Inc. (VHB) has performed a review of the Phase 1 study detailed in the "Final Report – Charles River Basin Infrastructure Synchronization Project" dated August 2008, completed by BETA Group, et al. This review is in support of GeoComp Corporation's efforts to conduct the Active Risk Management and Sequencing project for MassDOT's Accelerated Bridge Program (ABP),

Although the original study by the BETA Group was an extensive, 8-month evaluation of sequencing options associated with the Charles River Basin's ABP, it is important to note that the VHB review summarized in this memorandum is not a complete reanalysis of the work completed as part of the Phase 1 study.. The following memorandum presents preliminary findings associated with using the newly created Charles River Basin travel demand model in evaluation of a select number of projects with regard to sequencing. These selected projects differ slightly from the original study done in 2008, due to the fact that a number of projects (including BU Bridge, Craigie Dam, etc.) are already under construction, and have established schedules for completion.

This evaluation and associated conclusions were completed based on the review of model-developed anticipated shifts in vehicular traffic associated with various sequencing options. After these preliminary findings are presented, VHB will complete a more thorough analysis, intersection by intersection, to develop related mitigation for the preferred sequence.

VHB also reviewed the origin-destination (O-D) information provided in the Phase 1 report. The original information was developed primarily based on the CTPS regional travel demand model through limited select link analysis. VHB has updated this information based on the new local Charles River Basin travel demand model and presents the information herein.

The following represents key assumptions by VHB used to complete the review of the 2008 Phase I BETA Group study:

- The O-D model results are present exactly as processed, i.e., not rounded. Future use of this information should take into account that the model is only a tool and percentages provided herein are representative only and approximate
- The O-D model results represent a pre-construction condition (prior to any CRB bridge reconstruction activities)
- Review and analysis conducted to date with regard to sequencing has focused on vehicular traffic only (future analysis will include transit, pedestrian, bicycle, etc. provided by CTPS)
- Review and analysis conducted to date with regard to sequencing has focused on local traffic circulation only (future regional analysis will be provided by CTPS)
- Sequencing scenarios modeled herein assumed BU Bridge and Craigie Dam construction schedules and staging per current contract documents and information provided by MassDOT
- Sequencing scenarios modeled herein assumed Longfellow Bridge construction to commence immediately following completion of Craigie Dam construction (i.e., May 2011) and be staged as detailed in current 25% design documents and information provided by MassDOT
- Sequencing scenarios modeled herein assume, once started, the Longfellow Bridge to be under construction through the end of the ABP (2016)
- Anderson Memorial, Western Avenue and River Street bridges will not be ready (earliest August 2011) for construction until after Craigie Dam (April 2011) construction is complete and BU Bridge (December 2011) is substantially complete
- Given their early status of design, traffic management plans (TMPs) modeled for Anderson Memorial (1 lane taken in each direction per stage), Western Avenue (1 lane taken per stage) and River Street (1 lane taken per stage) were assumed based on discussions with MassDOT
- Western Avenue and River Street bridges packaged together or bundled for simultaneous construction
- As available, information from other potentially conflicting non-ABP projects was included in the analysis. As the details of other non-ABP projects (i.e., schedules and TMPs) become known, the analysis may need to be revisited

With regard to sequencing, given that certain bridges are already under construction (BU and Craigie Dam) or have a critical (i.e., inflexible) schedules (Longfellow Bridge), there are a limited number of sequencing scenarios to consider for future planning purposes. Once started, it is assumed that the Longfellow Bridge reconstruction will continue to the end of the ABP (2016). Further, based on information from MassDOT, it is unlikely that the Anderson Memorial, Western Avenue or River Street bridges will be ready for construction prior to completion, or substantial completion, of the BU Bridge and Craigie Dam Bridge reconstruction.

Taking into consideration the above assumptions and constraints, the sequencing scenarios that will be considered in this memorandum are how to sequence the reconstruction of the Anderson Memorial, Western Avenue and River Street bridges during various stages of the Longfellow Bridge reconstruction.

The results of the preliminary (review of traffic shifts only) analysis conducted herein indicate that it may be possible, from a traffic perspective, to simultaneously reconstruct the Anderson Memorial, Western Avenue and River Street bridges. It would be preferable to complete these concurrently with the City of Cambridge's sewer and roadway project and during the less restrictive phases of the Longfellow Bridge reconstruction (prior to 2014). Based on our analysis, it does not appear that concurrent construction of the 3 bridges presents a significantly more impactful environment than

constructing them separately. The anticipated completion of the BU Bridge in December 2011, will allow it, and other adjacent bridges for example, the Massachusetts Avenue bridge, to begin to address traffic shifts related to Anderson/Western/River construction activities. This is contingent upon the review of the present TMPs for these bridges. More restrictive TMPs (i.e., taking of more travel lanes) could modify this conclusion.

The Craigie Dam Bridge does not appear to be impacted significantly by the Anderson/Western/River construction. However, the largest traffic shifts projected by the traffic model are related to the Longfellow Bridge reconstruction activities and impact Craigie Dam, Leverett Circle, and other adjacent intersections along O'Brien Highway. Subsequent analyses will be completed by VHB to evaluate the potential impacts related to this anticipated traffic diversion regardless of other project schedules or sequencing considerations. This is also true for the outbound restriction only and the more restrictive Longfellow Bridge construction stages that follow.

If it is determined that the Anderson/Western/River bridge construction periods are not preferred or able to be concurrent, it would be advantageous to have the Western Avenue and River Street Bridge construction periods coincide with the City of Cambridge's Western Avenue Sewer Reconstruction project. Design or procurement delays, or impacts of other non-ABP area projects that are not established at this time, could result in an environment where reconstruction of these three (3) bridges may not be able or preferred to be concurrent.

The concern over the Longfellow Bridge and Craigie Dam Bridge relationship, from a traffic perspective during construction, is also being evaluated separately by VHB. The current Craigie Dam TMP is being reevaluated and a potential 'soft closure' of the Longfellow Bridge outbound movement is being analyzed and planned for later in 2010. Additional information will be provided under separate cover on these subjects as soon as it becomes available.

The results and conclusions presented in this memorandum are based on preliminary evaluation of potential traffic shifts related to alternate construction sequencing from the Charles River Basin travel demand model. It should be noted that numerous assumptions were made with regard to schedule, TMPs, and other non-ABP projects for this review. These assumptions could, and most likely will change in the future and the results and conclusions provided herein could be significantly modified. Further, we recommended further evaluation of potential sequencing impacts on an intersection by intersection basis to confirm conclusions summarized in this memorandum. This further evaluation will also provide additional details necessary for mitigation measures.

INTRODUCTION

To support GeoComp Corporation's efforts to conduct the Active Risk Management and Sequencing project for the MassDOT's Accelerated Bridge Program, VHB has revisited the Phase 1 study detailed in the "Final Report – Charles River Basin Infrastructure Synchronization Project" dated August 2008, completed by BETA Group, et al. This effort included updating the existing origin and destination data for vehicles travelling over study area bridges and an evaluation of several potential sequencing scenarios for bridge projects to determine the most favorable construction schedule from a traffic (vehicular) perspective. To conduct both analyses, VHB utilized the Charles River Basin subarea (local) travel demand model that was developed by VHB as part of a previous task. This memorandum details the methodology and results of the origin-destination review and the sequencing evaluation.

ORIGIN-DESTINATION (O-D) REVIEW

VHB conducted a review of the existing origin-destination (O-D) pairs for vehicles using study area bridges. This effort utilized the local travel demand model and reflects O-D data representative of patterns prior to any bridge construction (i.e., before the potential effects of current BU Bridge and Craigie Dam construction). The results of this review facilitate a more comprehensive understanding of travel patterns in the study area and subsequent sequencing evaluations and recommendations.

Methodology

To determine the pre-construction origins and destinations of vehicles travelling over the basin bridges, a select link analysis was performed at the ABP Charles River Basin project bridges, as well as those other bridges within the basin not slated for construction. The select link analysis tracks all vehicles travelling over a bridge, which in turn allows for the O-D pairs to be determined. The following bridges were included in the evaluation:

- Eliot Bridge
- Anderson Bridge
- Western Avenue Bridge
- River Street Bridge
- BU Bridge
- Massachusetts Avenue (Harvard) Bridge
- Longfellow Bridge
- Craigie Bridges
- North Washington Street (Charlestown) Bridge

Given the large number of traffic analysis zones in the Charles River basin subarea model (837 zones); these zones were aggregated into 35 geographical areas as shown in Figure 1. This aggregation will allow for an easier interpretation and use of the resultant O-D data.

Results

The select link analysis results show the proportion of vehicles traveling across a specific bridge and their origin and destination from all 35 geographical areas. The information is presented by peak hour (i.e., morning (AM) or evening (PM)) and for inbound (to Boston) and outbound (to Cambridge) movements. ***The model results are presented exactly as processed, i.e., not rounded. Future use of this information should take into account that the model is only a tool and percentages provided herein are representative only and approximate.***

For certain trips between zones no bridge crossing is necessary; for instance a driver going from Cambridgeport to Arlington would not need to cross a bridge. Further, some O-D pairs are very small or non-existent, and therefore, only the top five origin and destination patterns were reported for both the morning and evening peak hours (the remaining presented as "All other TAZ's"). Western Avenue and River Street bridges are presented together in Table 3. Tables 1 through 8 depict the results for all bridges evaluated.

Table 1
Eliot Bridge Origins and Destinations

Inbound			Outbound		
Origin TAZ	AM	PM	Origin TAZ	AM	PM
18 Cambridge - Mt. Auburn Hospital	4.3%	3.9%	2 Boston - Back Bay	11.6%	24.4%
23 West Cambridge/East Watertown	5.2%	7.6%	11 Boston - Northeastern/Roxbury/Fells	7.2%	8.9%
31 External - Watertown/Belmont	60.0%	33.2%	12 Boston - Financial District/Chinatown	3.9%	10.6%
34 External - Somerville/Arlington/Medford	30.5%	55.3%	21 Boston - Southwest Allston/Brighton (WGBH)	8.0%	3.1%
- -	-	-	22 Boston - Northwest Allston/Brighton (Residential)	16.2%	9.0%
- -	-	-	29 External South - Riverway to Mass Ave	13.7%	6.7%
- All other TAZ's	0.0%	0.0%	- All other TAZ's	39.4%	37.3%
- Total	100.0%	100.0%	- Total	100.0%	100.0%

Inbound			Outbound		
Destination TAZ	AM	PM	Destination TAZ	AM	PM
2 Boston - Back Bay	20.5%	14.1%	18 Cambridge - Mt. Auburn Hospital	8.3%	7.3%
4 Boston - Fenway/Kenmore	8.0%	7.0%	23 West Cambridge/East Watertown	8.8%	5.8%
11 Boston - Northeastern/Roxbury/Fells	6.4%	6.9%	31 External - Watertown/Belmont	29.2%	39.3%
12 Boston - Financial District/Chinatown	9.5%	3.8%	34 External - Somerville/Arlington/Medford	53.6%	47.5%
29 External South - Riverway to Mass Ave	12.1%	10.4%	- -	-	-
30 External - Brookline	2.3%	9.0%	- -	-	-
- All other TAZ's	41.2%	48.8%	- All other TAZ's	0.1%	0.1%
- Total	100.0%	100.0%	- Total	100.0%	100.0%

Table 2
Anderson Bridge Origins and Destinations

Inbound				Outbound			
Origin TAZ		AM	PM	Origin TAZ		AM	PM
14	Cambridge – Harvard Square	7.0%	14.0%	2	Boston – Back Bay	2.3%	5.6%
17	Cambridge – Harvard Law/Somerville	4.2%	13.0%	13	Boston – North Allston/Brighton (Harvard)	2.6%	7.0%
18	Cambridge – Mt. Auburn Hospital	21.5%	19.0%	19	Brookline	4.9%	1.8%
20	East Cambridge – Museum of	0.4%	0.5%	22	Boston – Northwest Allston/Brighton (Residential)	4.2%	5.9%
31	External – Watertown/Belmont	17.4%	0.0%	29	External South – Riverway to Mass Ave	5.4%	3.7%
34	External – Somerville/Arlington/Medford	48.2%	23.4%	30	External – Brookline	4.1%	15.8%
-	-	-	-	35	External – Soldiers Field Road/Market Street	52.7%	27.6%
-	All other TAZ's	1.3%	0.1%	-	All other TAZ's	23.8%	32.6%
-	Total	100.0%	100.0%	-	Total	100.0%	100.0%

Inbound				Outbound			
Destination TAZ		AM	PM	Destination TAZ		AM	PM
2	Boston – Back Bay	14.5%	5.2%	7	Cambridge - Kendall/Central	5.5%	2.6%
4	Boston – Fenway/Kenmore	9.7%	5.4%	14	Cambridge - Harvard Square	22.3%	23.9%
13	Boston – North Allston/Brighton (Harvard)	4.1%	9.3%	17	Cambridge - Harvard Law/Somerville	16.7%	19.4%
26	External – Ted Williams Tunnel	8.5%	6.5%	18	Cambridge - Mt. Auburn Hospital	25.7%	35.2%
29	External South – Riverway to Mass Ave	7.5%	8.8%	34	External - Somerville/Arlington/Medford	19.7%	16.1%
30	External – Brookline	6.6%	11.0%	-	-	-	-
35	External - Soldiers Field Road/Market Station	9.5%	11.5%	-	-	-	-
-	All other TAZ's	39.6%	42.3%	-	All other TAZ's	10.1%	2.8%
-	Total	100.0%	100.0%	-	Total	100.0%	100.0%

Table 3
Western Avenue (Inbound)/River Street (Outbound) Bridge Origins and Destinations

Inbound				Outbound			
Origin TAZ		AM	PM	Origin TAZ		AM	PM
5	Cambridge - MIT	10.4%	8.3%	10	Boston - Northeast Allston/Brighton (I-90 Ramps)	4.3%	2.7%
6	Cambridge - Cambridgeport	23.7%	23.0%	13	Boston - North Allston/Brighton (Harvard)	3.8%	8.6%
7	Cambridge - Kendall/Central	18.5%	24.9%	22	Boston - Northwest Allston/Brighton (Residential)	5.5%	4.3%
14	Cambridge - Harvard Square	16.0%	16.5%	30	External - Brookline	12.6%	10.1%
17	Cambridge - Harvard Law/Somerville	10.6%	8.5%	32	External - MassPike West	42.7%	36.5%
34	External - Somerville/Arlington/Medford	11.9%	3.8%	35	External - Soldiers Field Road/Market Street	11.8%	18.1%
-	All other TAZ's	8.9%	15.0%	-	All other TAZ's	19.3%	19.7%
-	Total	100.0%	100.0%	-	Total	100.0%	100.0%

Inbound				Outbound			
Destination TAZ		AM	PM	Destination TAZ		AM	PM
10	Boston - Northeast Allston/Brighton (I-90 Ramps)	4.9%	4.2%	5	Cambridge - MIT	18.6%	6.3%
13	Boston - North Allston/Brighton (Harvard)	10.2%	7.1%	6	Cambridge - Cambridgeport	24.0%	37.8%
22	Boston - Northwest Allston/Brighton (Residential)	9.7%	6.9%	7	Cambridge - Kendall/Central	25.9%	15.4%
30	External - Brookline	3.1%	5.5%	14	Cambridge - Harvard Square	8.8%	8.7%
32	External - MassPike West	35.5%	30.5%	20	East Cambridge - Museum of Science/Somerville	4.7%	4.3%
35	External - Soldiers Field Road/Market Street	22.3%	31.4%	34	External - Somerville/Arlington/Medford	2.0%	14.0%
-	All other TAZ's	14.3%	14.4%	-	All other TAZ's	16.0%	13.5%
-	Total	100.0%	100.0%	-	Total	100.0%	100.0%

Table 4
BU Bridge Origins and Destinations

Inbound			Outbound		
Origin TAZ	AM	PM	Origin TAZ	AM	PM
5 Cambridge - MIT	8.4%	14.3%	4 Boston - Fenway/Kenmore	19.0%	20.8%
6 Cambridge - Cambridgeport	16.8%	40.6%	9 Boston - Southeast Allston/Brighton (BU	3.6%	4.5%
7 Cambridge - Kendall/Central	7.5%	13.6%	19 Brookline	16.9%	12.4%
14 Cambridge - Harvard Square	6.7%	14.7%	24 Boston - Longwood Medical	2.9%	13.5%
17 Cambridge - Harvard Law/Somerville	4.9%	4.1%	29 External South - Riverway to Mass Ave	18.4%	19.1%
34 External - Somerville/Arlington/Medford	28.6%	4.1%	30 External - Brookline	38.4%	27.6%
- All other TAZ's	27.1%	8.6%	- All other TAZ's	0.8%	2.1%
- Total	100.0%	100.0%	- Total	100.0%	100.0%

Inbound			Outbound		
Destination TAZ	AM	PM	Destination TAZ	AM	PM
4 Boston - Fenway/Kenmore	12.1%	11.2%	5 Cambridge - MIT	30.3%	13.3%
19 Brookline	14.1%	12.7%	6 Cambridge - Cambridgeport	38.4%	20.1%
24 Boston - Longwood Medical	18.7%	6.4%	7 Cambridge - Kendall/Central	10.4%	17.0%
29 External South - Riverway to Mass Ave	11.9%	19.6%	14 Cambridge - Harvard Square	6.3%	8.2%
30 External - Brookline	32.9%	44.1%	34 External - Somerville/Arlington/Medford	6.2%	14.3%
- -	-	-	- -	-	-
- All other TAZ's	10.3%	6.0%	- All other TAZ's	8.4%	27.1%
- Total	100.0%	100.0%	- Total	100.0%	100.0%

Table 5
Massachusetts Avenue (Harvard) Bridge Origins and Destinations

Inbound			Outbound		
Origin TAZ	AM	PM	Origin TAZ	AM	PM
5 Cambridge - MIT	14.9%	23.5%	2 Boston - Back Bay	14.5%	36.8%
6 Cambridge - Cambridgeport	11.3%	14.5%	4 Boston - Fenway/Kenmore	4.5%	4.8%
7 Cambridge - Kendall/Central	19.4%	29.4%	11 Boston - Northeastern/Roxbury/Fells	4.2%	14.0%
14 Cambridge - Harvard Square	3.3%	5.3%	19 Brookline	4.3%	0.8%
17 Cambridge - Harvard Law/Somerville	4.8%	7.0%	29 External South - Riverway to Mass Ave	27.9%	26.3%
27 External - East Locations (Tobin Br./Broadway)	8.4%	2.7%	30 External - Brookline	32.2%	4.9%
34 External - Somerville/Arlington/Medford	19.1%	4.6%	- -	-	-
- All other TAZ's	18.8%	13.0%	- All other TAZ's	12.4%	12.4%
- Total	100.0%	100.0%	- Total	100.0%	100.0%

Inbound			Outbound		
Destination TAZ	AM	PM	Destination TAZ	AM	PM
2 Boston - Back Bay	22.2%	11.3%	5 Cambridge - MIT	18.0%	17.0%
4 Boston - Fenway/Kenmore	10.8%	7.4%	6 Cambridge - Cambridgeport	11.2%	7.6%
11 Boston - Northeastern/Roxbury/Fells	12.5%	8.7%	7 Cambridge - Kendall/Central	33.6%	24.0%
29 External South - Riverway to Mass Ave	31.8%	30.0%	8 Boston - Charlestown	6.4%	2.8%
30 External - Brookline	6.4%	18.2%	14 Cambridge - Harvard Square	6.3%	10.1%
32 External - MassPike West	5.5%	10.3%	17 Cambridge - Harvard Law/Somerville	5.0%	10.7%
- -	-	-	34 External - Somerville/Arlington/Medford	5.5%	13.4%
- All other TAZ's	10.8%	14.1%	- All other TAZ's	14.0%	14.4%
- Total	100.0%	100.0%	- Total	100.0%	100.0%

Table 6
Longfellow Bridge Origins and Destinations

Inbound			Outbound		
Origin TAZ	AM	PM	Origin TAZ	AM	PM
5 Cambridge - MIT	12.9%	30.2%	3 Boston - Beacon Hill	18.3%	16.5%
6 Cambridge - Cambridgeport	9.2%	8.7%	12 Boston - Financial District/Chinatown	13.7%	20.2%
7 Cambridge - Kendall/Central	44.4%	41.2%	15 Boston - MGH/Government Center	8.1%	12.0%
14 Cambridge - Harvard Square	5.6%	5.5%	25 External - Callahan Tunnel/Sumner Tunnel	7.3%	8.3%
34 External - Somerville/Arlington/Medford	9.9%	7.3%	28 External - I-93 South/Southeast Expressway	37.8%	15.9%
- -	-	-	33 External - I-93 North	2.6%	15.2%
- All other TAZ's	18.0%	7.1%	- All other TAZ's	12.2%	11.9%
- Total	100.0%	100.0%	- Total	100.0%	100.0%

Inbound			Outbound		
Destination TAZ	AM	PM	Destination TAZ	AM	PM
2 Boston - Back Bay	7.9%	5.1%	5 Cambridge - MIT	25.6%	13.0%
3 Boston - Beacon Hill	38.6%	44.7%	6 Cambridge - Cambridgeport	8.4%	6.7%
12 Boston - Financial District/Chinatown	21.0%	13.4%	7 Cambridge - Kendall/Central	46.6%	17.9%
15 Boston - MGH/Government Center	18.1%	12.6%	14 Cambridge - Harvard Square	9.8%	14.4%
28 External - I-93 South/Southeast Expressway	3.5%	7.0%	17 Cambridge - Harvard Law/Somerville	4.0%	10.1%
- -	-	-	34 External - Somerville/Arlington/Medford	3.2%	22.0%
- All other TAZ's	10.9%	17.2%	- All other TAZ's	2.4%	15.9%
- Total	100.0%	100.0%	- Total	100.0%	100.0%

Table 7
Craigie Dam Bridge Origins and Destinations

Inbound			Outbound		
Origin TAZ	AM	PM	Origin TAZ	AM	PM
7 Cambridge - Kendall/Central	14.2%	31.3%	2 Boston - Back Bay	6.9%	4.3%
8 Boston - Charlestown	9.1%	7.7%	3 Boston - Beacon Hill	12.6%	5.9%
17 Cambridge - Harvard Law/Somerville	9.6%	8.7%	12 Boston - Financial District/Chinatown	8.8%	6.2%
20 East Cambridge - Museum of Science/Somerville	10.4%	21.9%	15 Boston - MGH/Government Center	18.0%	14.1%
27 External - East Locations (Tobin Br./Broadway)	9.9%	5.2%	28 External - I-93 South/Southeast Expressway	30.0%	15.1%
34 External - Somerville/Arlington/Medford	36.1%	12.7%	30 External - Brookline	1.4%	9.3%
- -	-	-	33 External - I-93 North	3.8%	13.0%
- All other TAZ's	10.7%	12.5%	- All other TAZ's	18.5%	32.1%
- Total	100.0%	100.0%	- Total	100.0%	100.0%

Inbound			Outbound		
Destination TAZ	AM	PM	Destination TAZ	AM	PM
2 Boston - Back Bay	10.4%	6.5%	7 Cambridge - Kendall/Central	31.2%	18.2%
12 Boston - Financial District/Chinatown	14.9%	9.7%	8 Boston - Charlestown	10.7%	15.4%
15 Boston - MGH/Government Center	9.7%	8.6%	17 Cambridge - Harvard Law/Somerville	11.0%	9.7%
28 External - I-93 South/Southeast Expressway	14.2%	14.8%	20 East Cambridge - Museum of Science/Somerville	21.6%	15.2%
29 External South - Riverway to Mass Ave	6.9%	11.4%	27 External - East Locations (Tobin Br./Broadway)	2.8%	11.3%
33 External - I-93 North	1.3%	8.1%	34 External - Somerville/Arlington/Medford	6.7%	18.7%
- All other TAZ's	42.6%	40.9%	- All other TAZ's	16.0%	11.5%
- Total	100.0%	100.0%	- Total	100.0%	100.0%

Table 8
North Washington Bridge Origins and Destinations

Inbound			Outbound		
Origin TAZ	AM	PM	Origin TAZ	AM	PM
7 Cambridge - Kendall/Central	0.4%	1.2%	3 Boston - Beacon Hill	10.1%	7.2%
8 Boston - Charlestown	30.2%	41.9%	12 Boston - Financial District/Chinatown	5.9%	10.6%
20 East Cambridge - Museum of	3.7%	5.6%	15 Boston - MGH/Government Center	15.1%	17.9%
27 External - East Locations (Tobin Bridge -	35.6%	28.4%	16 Boston - North End	34.0%	45.8%
34 External -	28.5%	20.4%	28 External - I-93 South/Southeast	17.9%	10.0%
- -	-	-	- -	-	-
- All other TAZ's	1.6%	2.5%	- All other TAZ's	17.0%	8.5%
- Total	100.0%	100.0%	- Total	100.0%	100.0%

Inbound			Outbound		
Destination TAZ	AM	PM	Destination TAZ	AM	PM
3 Boston - Beacon Hill	8.2%	9.4%	7 Cambridge - Kendall/Central	3.3%	0.7%
12 Boston - Financial District/Chinatown	14.0%	17.1%	8 Boston - Charlestown	64.7%	30.3%
15 Boston- MGH/Government Center	22.4%	23.2%	20 East Cambridge - Museum of	1.6%	0.6%
16 Boston - North End	19.1%	43.7%	27 External - East Locations (Tobin Bridge -	17.1%	36.6%
25 External - Callahan Tunnel/Sumner	2.3%	4.2%	30 External - Brookline	0.4%	0.8%
28 External - I-93 South/Southeast	15.2%	1.2%	34 External -	7.9%	25.1%
32 External - MassPike West	8.4%	0.4%	- -	-	-
- All other TAZ's	10.4%	0.8%	- All other TAZ's	5.0%	5.9%
- Total	100.0%	100.0%	- Total	100.0%	100.0%

SEQUENCING EVALUATION

This section presents a preliminary evaluation of the Charles River Basin Accelerated Bridge Program construction sequencing as proposed as part of the Phase 1 study. The results of this evaluation will ultimately assist in establishing potential revisions or modifications to sequencing for future bridge projects.

Modeling/Analysis Assumptions:

- Review and analysis conducted to date with regard to sequencing has focused on vehicular traffic only (future analysis will include transit, pedestrian, bicycle, etc. provided by CTPS)
- Review and analysis conducted to date with regard to sequencing has focused on local traffic circulation only (future regional analysis will be provided by CTPS)
- Sequencing scenarios modeled herein assumed BU Bridge and Craigie Dam construction schedules and staging per current contract documents and information provided by MassDOT
- Sequencing scenarios modeled herein assumed Longfellow Bridge construction to commence immediately following completion of Craigie Dam construction (i.e., May 2011) and be staged as detailed in current 25% design documents and information provided by MassDOT
- Sequencing scenarios modeled herein assume, once started, the Longfellow Bridge to be under construction through the end of the ABP (2016)
- Anderson Memorial, Western Avenue and River Street bridges will not be ready (earliest August 2011) for construction until after Craigie Dam (April 2011) construction is complete and BU Bridge (December 2011) is substantially complete

- Given their early status of design, traffic management plans (TMPs) modeled for Anderson Memorial (1 lane taken in each direction per stage), Western Avenue (1 lane taken per stage) and River Street (1 lane taken per stage) were assumed based on discussions with MassDOT
- Western Avenue and River Street bridges packaged for simultaneous construction
- As available, information from other potentially conflicting non-ABP projects was included in the analysis. As the details of other non-ABP projects (i.e., schedules and TMPs) become known, the analysis may need to be revisited

Scenarios Analyzed

The following six scenarios were modeled to develop a preferred construction sequence from a traffic perspective. It should be noted that at the time of this report certain bridges are already under construction (BU Bridge and Craigie Dam Bridge) or have critical (inflexible) schedules (Longfellow Bridge). Therefore, the number of potential sequencing scenarios is somewhat limited and consists mostly of a determination of the future sequencing between the Anderson Memorial and Western Avenue/River Street Bridges, as related to Longfellow Bridge construction. As noted above, the Anderson Memorial and Western Avenue/River Street bridges' likely construction staging have been assumed based on discussions with MassDOT.

- **BASELINE** - Spring 2011 model run with Craigie Dam (two lanes in each direction) and BU Bridge (one lane in each direction) under construction.
- **LONGFELLOW BASELINE** - Isolated Longfellow Bridge model run with the outbound (Boston to Cambridge) movement closed.
- **ANDERSON/WESTERN/RIVER TOGETHER** - Fall 2012 model run with the Longfellow Bridge outbound movement closed and the Western Avenue, River Street and Anderson Memorial bridges all under construction simultaneously (one lane removed in each direction on Anderson Memorial, and one lane removed on River Street and Western Avenue).
- **ANDERSON FIRST** - Fall 2012 model run with the Longfellow Bridge outbound movement closed and the Anderson Bridge (only) under construction (with one lane removed in each direction).
- **WESTERN/RIVER FIRST** - Fall 2012 model run with the Longfellow Bridge outbound movement closed and the Western Avenue and River Street bridges (only) under construction (with one lane removed on each)
- **ANDERSON LAST** - Fall 2014 model run with the Longfellow Bridge outbound movement closed plus one lane removed in the inbound direction and the Anderson Bridge (only) under construction (with one lane removed in each direction). *This scenario was developed to assess the impacts of delaying Anderson (Western/River preferred to proceed simultaneously with City of Cambridge project in 2012)*

Other Projects

There are a number of other projects not associated with the Charles River Basin Accelerated Bridge Program that are expected to occur during the same time period (2010-2016) that could impact the basin and traffic operations. Given the uncertainty regarding the scheduling and nature of these projects at this time, they have not been included in this analysis – *the exception being the City of Cambridge's Western Avenue Sewer Rehabilitation Project*. As more detailed information (i.e., schedule and construction staging) is established regarding any particular project, they will be incorporated into more detailed assessments and future analyses. These projects include, but are not limited to:

- North Washington Street bridge in Boston

- Massachusetts Avenue bridge over Commonwealth Avenue in Boston
- Commonwealth Avenue bridge over I-90 (Turnpike) in Boston
- Memorial Drive improvements in Cambridge
- Western Avenue improvements in Cambridge (*included*)

Scenario Modeling and Analysis

BASELINE - Spring 2011: BU and Craigie Dam Bridges Construction

This scenario assumes that the BU Bridge has been reduced from four lanes total to two (one lane in each direction) and that the Craigie Dam Bridge has the inbound direction (Cambridge to Boston) reduced from three lanes to two lanes while the outbound direction retains the existing two lanes. The Craigie Dam Bridge configuration modeled was chosen based on the current construction proposal, which has this configuration during the majority of the significant construction activities (November 2010 to April 2011). It is understood that during select periods of time, the bridge cross-section will be further reduced from four lanes total, to three lanes and/or two lanes depending on the work being conducted. A separate detailed analysis to evaluate these more restrictive scenarios is being prepared and will be provided to MassDOT under a separate cover.

Figures 2 and 3 depict the difference in volumes (i.e., anticipated traffic circulation changes) resulting from the reduction in capacity (i.e., lanes) on these two bridges. Table 9 summarizes the changes in volume at the adjacent river crossings. These results are presented as either an increase or decrease (-) in peak hour traffic volumes (vehicles per hour).

Table 9
BASELINE - Spring 2011 Scenario

Charles River Crossing	Morning Peak Hour		Evening Peak Hour	
	Inbound	Outbound	Inbound	Outbound
N. Washington St. Bridge	<50	<50	<50	<50
I-93	<50	<50	<50	<50
Craigie Dam Bridge	-120	<50	<50	<50
Longfellow Bridge	50-100	50-100	<50	<50
Mass. Ave Bridge	150	280	140	160
BU Bridge	-340	-620	-560	-460
Western Ave/River St. Bridges	<100	120	200	50-100
Anderson Bridge	<50	50-100	<50	50-100
Eliot Bridge	<50	<50	<50	<50
Arsenal St. Bridge	<50	<50	<50	<50

As can be seen in the table, and as would be expected, the model projects pre-construction traffic volumes on the BU, and to a lesser extent the Craigie Dam bridges, to be reduced based on the construction activity. The Craigie Dam Bridge experiences less of a reduction, especially in the outbound direction, because the two lanes in each direction scenario assumed is not significantly different than the pre-construction cross section (in fact the outbound direction is the same).

The Massachusetts Avenue (Harvard) Bridge accommodates the majority of the displaced vehicles from the BU and Craigie Dam Bridge construction activities. The Anderson Memorial Bridge and Western Avenue/River Street Bridges have the next largest increases. The remaining shifted vehicles are distributed somewhat evenly across the other Charles River crossings including the North Washington Bridge, I-93, Eliot Bridge, and the Arsenal Street Bridge. Additionally, some vehicles currently travel across the River twice; for instance drivers cross the Eliot Bridge to use Storrow Drive, which is faster than Memorial Drive, and then use the Craigie Dam Bridge to access

East Cambridge. Some of these drivers, considering the construction activities, may now choose to remain on the same side (i.e., Memorial Drive) of the river and would no longer be counted in the bridges' volumes.

For this BASELINE condition, VHB was able to compare the decrease in volumes predicted by their Traffic Model across the BU Bridge with pre-construction volumes collected by the BETA Group, Inc. in their Phase 1 Study, and post-construction volumes collected by Howard/Stein-Hudson and Associates at this location. It was found, as shown in Table 10, that the model estimations correlate very well with the actual observed reduction in traffic on the BU Bridge.

Table 10
BU Bridge Construction-Volume Reduction Comparison

	Morning Peak Hour		Evening Peak Hour	
	Inbound	Outbound	Inbound	Outbound
Counts*	-340	-670	-560	-320
Model	-340	-620	-560	-460

* Based on Howard/Stein-Hudson and BETA counts.

As this BASELINE scenario represents construction stages actually experienced at various times during the past year (2009-2010), it can provide good insight regarding accommodations for TMPs and anticipated shifts in traffic. While the BU bridge intersections have experienced some delay increases during construction, for the most part traffic has been successfully processed with the assistance of police details on the Boston side of the Bridge. Similarly, the Route 28/Land Boulevard and Leverett Circle intersections at the ends of the Craigie Dam Bridge have experienced a decrease in their level of operations; however, traffic has been able to be processed without significant impacts. Finally, the other bridges (Massachusetts Avenue, Western Avenue, River Street, Anderson Memorial) have been able to adequately accommodate the additional volume of shifted traffic related to the BU and Craigie Dam Bridges construction.

LONGFELLOW BASELINE - Fall 2012: Longfellow Bridge (only) Construction

Prior to layering additional construction projects onto the Longfellow Bridge reconstruction it is necessary to understand the traffic implications associated with the proposed TMPs for the Longfellow Bridge Phase II construction only. This is critical given that, once started, it is assumed that the Longfellow Bridge will be under construction for the entire duration of the ABP and will impact and be impacted by the remaining projects. This scenario was conducted to evaluate the isolated impacts of the currently proposed Longfellow Bridge TMP, which consists of completely closing the outbound direction (Boston to Cambridge) for the duration of the project. A more restrictive scenario is also being proposed by MassDOT later during construction that includes an additional inbound lane closed as well. This additional restriction is analyzed in the "Fall 2014 scenario", described later in this memorandum.

Figures 4 and 5 depict the difference in volumes (i.e., anticipated traffic circulation changes) resulting from the reduction in capacity (i.e., lanes) on the Longfellow Bridge. Table 11 summarizes the changes in volume at the adjacent river crossings. These results are presented as either an increase or decrease (-) in peak hour traffic volumes (vehicles per hour).

Table 11
LONGFELLOW BASELINE - Fall 2012 Longfellow Only Scenario

Charles River Crossing	Morning Peak Hour		Evening Peak Hour	
	Inbound	Outbound	Inbound	Outbound
N. Washington St. Bridge	<50	<50	<50	<50
I-93	<50	50-100	<50	<50
Craigie Bridges	<50	610	<50	450
Longfellow Bridge	-50	-1050	<50	-860
Mass. Ave Bridge	<50	160	<50	110
BU Bridge	<50	<50	<50	<50
Western Ave/River St. Bridges	<50	<50	<50	<50
Anderson Bridge	<50	<50	<50	<50
Eliot Bridge	<50	<50	<50	<50
Arsenal St. Bridge	<50	<50	<50	<50

Assuming the complete closure of the outbound (Boston to Cambridge) movement requires a significant shift (1050 vehicles during AM peak hour and 860 vehicles during the PM peak hour) away from the Longfellow Bridge. The model projects that the greatest increase in traffic volume related to this shift occurs at the Craigie Bridge, which is expected to accommodate between 50 percent and 60 percent of the displaced Longfellow vehicles. The next largest increase is observed at the Massachusetts Avenue (Harvard) Bridge. The remaining vehicles are distributed somewhat evenly throughout the basin at levels that should not significantly impact traffic volumes.

A detailed analysis will be conducted subsequently to determine whether the shifted traffic volumes can be accommodated by the other bridges, in particular the Craigie Dam Bridge and adjacent intersections, if the outbound direction on the Longfellow Bridge is restricted. The current traffic operational conditions at Leverett Circle and the O'Brien Highway/Gilmore Bridge/Land Boulevard intersections create a concern regarding the ability of these locations to absorb this significant a shift in traffic volume.

ANDERSON/WESTERN/RIVER TOGETHER - Fall 2012: Longfellow, Anderson Memorial, Western Avenue and River Street Bridges Construction

This scenario assumes that the Longfellow Bridge outbound direction is closed, and tests the ability for the remaining Charles River Basin ABP projects to occur simultaneously. For modeling purposes it is assumed that the Anderson Bridge is reduced to one lane in each direction and that the Western Avenue and River Street bridges are reduced from three lanes to two lanes each. Further, it assumes that the Western Avenue Sewer Reconstruction project in Cambridge (presently planned for 2012) results in a reduction in capacity along Western Avenue, from Massachusetts Avenue to Memorial Drive. Specifically, the Cambridge project is associated with sewer line work and subsequent roadway and sidewalk reconstruction.

Figures 6 and 7 depict the difference in volumes (i.e., anticipated traffic circulation changes) resulting from the reduction in capacity (i.e., lanes) on these bridges. Table 12 summarizes the changes in volume at the adjacent river crossings. These results are presented as either an increase or decrease (-) in peak hour traffic volumes (vehicles per hour).

Table 12

ANDERSON/WESTERN/RIVER TOGETHER - Fall 2012 Longfellow, Anderson, Western Ave and River St Scenario

Charles River Crossing	Morning Peak Hour		Evening Peak Hour	
	Inbound	Outbound	Inbound	Outbound
N. Washington St. Bridge	<50	<50	<50	<50
I-93	<50	50-100	<50	50-100
Craigie Bridges	50-100	610	<50	470
Longfellow Bridge	<50	-1050	<50	-860
Mass. Ave Bridge	<50	210	<50	160
BU Bridge	<50	50-100	<50	50-100
Western Ave/River St. Bridges	-150	-90	-180	<50
Anderson Bridge	-180	-170	<50	-190
Eliot Bridge	<50	50-100	<50	50-100
Arsenal St. Bridge	50-100	<50	<50	<50

As shown in the table, the analysis indicates that the proposed TMPs assumed for modeling purposes reflect some level of traffic reduction on Anderson Memorial, Western Avenue and River Street bridges. In tracking the shift in these volumes it can be seen that the impacts to the Craigie Dam Bridge are similar to those under the previous scenario (Longfellow Baseline) indicating that the traffic displaced from Anderson/Western/River is not adding to the increase at the Craigie Dam Bridge.

The Massachusetts Avenue Bridge experiences additional traffic increases beyond those occurring with only the Longfellow Bridge construction indicating it as an attractive alternative to the traffic displaced by the Anderson/Western/River construction. It is of note that the projected increases at Massachusetts Avenue are of the same magnitude experienced under the Spring 2011 scenario. Therefore, it could be inferred that the impacts on the operations of the Massachusetts Avenue Bridge (associated with constructing Anderson/Western/River simultaneously) would be similar to those that have already been experienced. Finally, the BU, Eliot and Arsenal Street bridges experience slight increases as well, however, no greater than 50 and 100 vehicles per hour.

Based on the estimated volume differences, it appears that all three bridges could be under construction simultaneously (and concurrent with Longfellow Bridge construction) from a traffic perspective as long as the contract documents TMPs reflect the assumptions analyzed and outlined above. From this preliminary analysis, it appears that the most significant traffic issues remain associated with the proposed Longfellow Bridge TMP. We propose to do additional intersection analysis directly related to this scenario to ascertain whether the additional traffic volumes shifted from Longfellow, as well as Anderson/Western/River, can be accommodated. We also propose to identify additional traffic mitigation measures.

ANDERSON FIRST - Fall 2012: Longfellow and Anderson Bridges Construction

This scenario was developed in conjunction with the subsequent scenario (Western/River construction first) to understand the individual impacts related to each bridge package. Note, as detailed above, this analysis assumes Western Avenue and River Street bridges packaged together for construction. This scenario also assumes that the Longfellow Bridge outbound direction is closed and the Anderson Bridge (only) is reduced to 1 lane in each direction. The Western Avenue Sewer Reconstruction Project in Cambridge is also included in this scenario.

Figures 8 and 9 depict the difference in volumes (i.e., anticipated traffic circulation changes) resulting from the reduction in capacity (i.e., lanes) on these bridges. Table 13 summarizes the

changes in volume at the adjacent river crossings. These results are presented as either an increase or decrease (-) in peak hour traffic volumes (vehicles per hour).

Table 13

ANDERSON FIRST - Fall 2012 Longfellow and Anderson Scenario

Charles River Crossing	Morning Peak Hour		Evening Peak Hour	
	Inbound	Outbound	Inbound	Outbound
N. Washington St. Bridge	<50	<50	<50	<50
I-93	<50	50-100	<50	50-100
Craigie Bridges	<50	600	<50	440
Longfellow Bridge	-60	-1050	<50	-860
Mass. Ave Bridge	<50	190	<50	150
BU Bridge	<50	<50	<50	50-100
Western Ave/River St. Bridges	<50	130	<50	130
Anderson Bridge	-220	-220	<50	-200
Eliot Bridge	50-100	50-100	<50	50-100
Arsenal St. Bridge	50-100	<50	<50	<50

As shown in the table, the analysis indicated traffic shifted from Longfellow and Anderson Memorial bridges as expected related to the assumed construction activities. However, similarly to the previous scenario (Anderson/Western/River together), the impacts to the Craigie Bridge can be almost exclusively traced to the Longfellow Bridge construction. The bridges most impacted by the Anderson Memorial bridge construction include the Massachusetts Avenue Bridge (experiencing a minor increase in traffic as compared to the Longfellow only closure scenario) and River Street Bridge. The Western Avenue Bridge volumes, however, do not increase significantly. This is most likely due to a combination of the City of Cambridge's Western Avenue Sewer Reconstruction Project and the lack of reduction in total inbound capacity in the system since only the outbound direction is closed on the Longfellow Bridge. The remaining shifted vehicles cross the river at the other locations, none of which experience a significant increase in volumes.

As before, the largest shifts related to this scenario are associated with the Longfellow Bridge Phase II construction. The Anderson Memorial Bridge construction's contribution to traffic shifts is somewhat equivalent to those associated with the current BU Bridge closure, which also results in one less lane of capacity in both the inbound and outbound directions across the river in the same proximity.

WESTERN/RIVER FIRST - Fall 2012: Longfellow, Western Avenue and River Street Bridges Construction

This scenario was developed in conjunction with the previous scenario (Anderson First) to understand the individual impacts related to each bridge package. Note, as detailed above, this analysis assumes Western Avenue and River Street bridges packaged together for construction. This scenario also assumes that the Longfellow Bridge outbound direction is closed and the Western Avenue and River Street bridges are reduced from three lanes to two lanes each. The Western Avenue Sewer Reconstruction project in Cambridge is also included.

Figures 10 and 11 depict the difference in volumes (i.e., anticipated traffic circulation changes) resulting from the reduction in capacity (i.e., lanes) on these bridges. Table 14 summarizes the changes in volume at the adjacent river crossings. These results are presented as either an increase or decrease (-) in peak hour traffic volumes (vehicles per hour).

Table 14

WESTERN/RIVER FIRST - Fall 2012 Longfellow, Western Ave and River St. Scenario

Charles River Crossing	Morning Peak Hour		Evening Peak Hour	
	Inbound	Outbound	Inbound	Outbound
N. Washington St. Bridge	<50	<50	<50	<50
I-93	<50	50-100	<50	50-100
Craigie Bridges	<50	610	<50	460
Longfellow Bridge	<50	-1050	<50	-860
Mass. Ave Bridge	<50	180	<50	120
BU Bridge	<50	<50	<50	<50
Western Ave/River St. Bridges	-140	-140	-200	-140
Anderson Bridge	<50	50-100	<50	110
Eliot Bridge	<50	<50	<50	<50
Arsenal St. Bridge	<50	<50	<50	<50

As shown in the table, the analysis indicates the degree to which traffic will be shifted from the Longfellow Bridge and the Western Avenue and River Street bridges associated with construction. This scenario is very comparable to the previous one, with the same number of lanes available throughout the basin. The one advantage of this sequencing versus the prior one is that the City of Cambridge's Western Avenue Sewer Reconstruction project coincides with the Western Avenue Bridge construction. Having both projects occurring simultaneously would be preferable to having a longer construction period on the Western Avenue corridor (i.e., first the Cambridge portion then the bridge portion). It should be noted, however, that the Cambridge project is in the early stages of planning. Therefore, it is possible that the project may be delayed, in which case it may be preferable to work on the Anderson Bridge first. Further coordination by MassDOT with the City of Cambridge is recommended to follow the planning of this project.

ANDERSON LAST - Fall 2014: Longfellow and Anderson Bridges Construction

This scenario was developed to test the potential impacts related to delaying the Anderson Memorial Bridge reconstruction. A delay could be related to a preference to not reconstruct Anderson/Western/River simultaneously, and preferring to complete the Western/River bridge projects with the City of Cambridge's Sewer Reconstruction project. It assumes that the Anderson Bridge is reduced to one lane in each direction and that the Longfellow Bridge Phase II construction, in addition to having the outbound direction restricted, has one inbound lane closed. The Cambridge Western Avenue Sewer Reconstruction project is assumed to have been completed by this time.

Figures 12 and 13 depict the difference in volumes (i.e., anticipated traffic circulation changes) resulting from the reduction in capacity (i.e., lanes) on these two bridges. Table 15 summarizes the changes in volume at the adjacent river crossings. These results are presented as either an increase or decrease (-) in peak hour traffic volumes (vehicles per hour).

As can be seen, the Craigie Dam Bridge generally continues to experience a large increase in peak hour traffic volumes, but in this alternative the inbound traffic is also significantly impacted. This is due to the additional one inbound lane closure on the Longfellow Bridge. In addition to the more restrictive Longfellow Bridge TMP, the Anderson Memorial Bridge reconstruction impacts the BU, River Street and Massachusetts Avenue bridges which all see increases of between 100 and 200 vehicles. As before, we recommend additional intersection by intersection analysis be performed related to this sequencing scenario. An additional analysis will also be performed by VHB to evaluate the more restrictive Longfellow Bridge TMP anticipated for 2014.

Table 15
ANDERSON LAST - Fall 2014 Scenario

Charles River Crossing	Morning Peak Hour		Evening Peak Hour	
	Inbound	Outbound	Inbound	Outbound
N. Washington St. Bridge	<50	<50	<50	<50
I-93	<50	50-100	<50	<50
Craigie Bridges	50-100	620	250	450
Longfellow Bridge	-120	-1050	-380	-860
Mass. Ave Bridge	<50	190	<50	130
BU Bridge	110	<50	<50	<50
Western Ave/River St. Bridges	<50	110	<50	130
Anderson Bridge	-150	-210	<50	-200
Eliot Bridge	-150	50-100	<50	50-100
Arsenal St. Bridge	50-100	<50	<50	<50

CONCLUSIONS

To support GeoComp Corporation's efforts to conduct the Active Risk Management and Sequencing Project for the MassDOT's Accelerated Bridge Program, VHB has revisited the Phase 1 study detailed in the "Final Report - Charles River Basin Infrastructure Synchronization Project" dated August 2008, completed by BETA Group, et al. This effort included updating the existing origin and destination data for vehicles travelling over study area bridges and an evaluation of several potential sequencing scenarios for bridge projects to determine the most favorable construction schedule from a traffic (vehicular) perspective.

The updated origin-destination data is provided herein and was developed using the local, subarea travel demand model developed by VHB for the Charles River Basin as part of this Project.

With regard to sequencing, given that certain bridges are already under construction (including the BU Bridge and the Craigie Dam Bridge) or have a critical (i.e., inflexible) schedules (including the Longfellow Bridge Phase II construction), there are a limited number of sequencing scenarios to consider for future planning purposes. Once started, it is assumed that the Longfellow Bridge Phase II reconstruction will continue to the end of the ABP (2016). Further, it is unlikely that the Anderson Memorial, Western Avenue or River Street bridges will be ready for construction prior to completion, or substantial completion, of the BU Bridge and Craigie Dam Bridge reconstruction.

Based on these assumptions and constraints, the only sequencing scenarios to be considered are how and when best to reconstruct the Anderson Memorial, Western Avenue and River Street bridges during various stages of the Longfellow Bridge reconstruction.

The results of the preliminary (review of traffic shifts only) analysis conducted herein indicate that it may be possible, from a traffic perspective, to simultaneously reconstruct the Anderson Memorial, Western Avenue and River Street bridges and that it would be preferable to complete these concurrent with the City of Cambridge's Sewer Reconstruction project and during less restrictive phases of Longfellow Bridge Phase II reconstruction (prior to 2014). This is not to say that there would not be traffic operational impacts within the basin, but it does not appear that concurrent construction presents a significantly more impactful environment than constructing them separately. The anticipated completion of the BU Bridge (December 2011) allow it, and other adjacent bridges (e.g., Massachusetts Avenue), to begin to address traffic shifts related to Anderson/Western/River

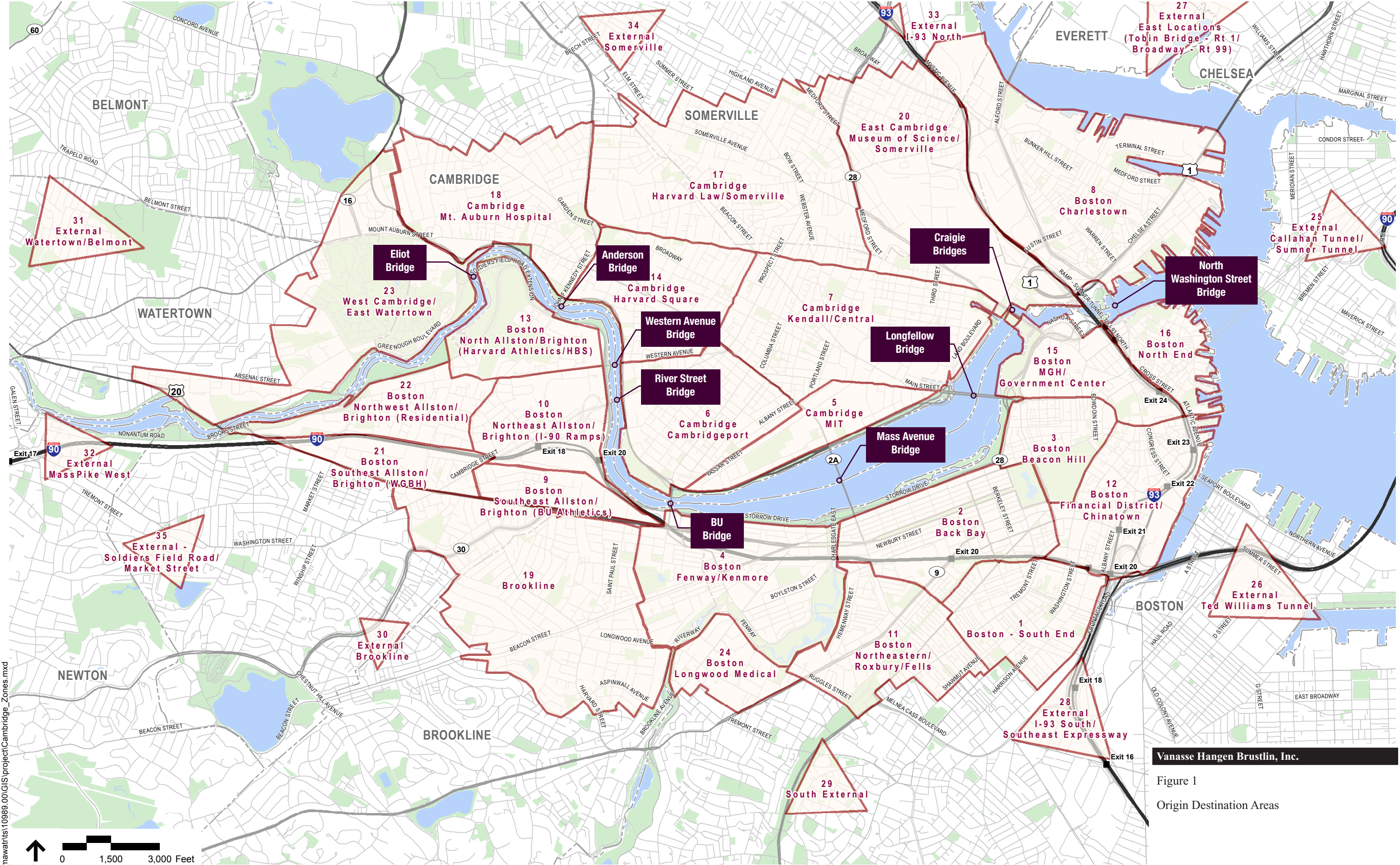
construction activities. This is contingent upon the assumed TMPs for these bridges as currently understood. More restrictive TMPs (i.e., taking of more travel lanes) could modify this conclusion.

The Craigie Dam Bridge does not appear to be impacted significantly by Anderson/Western/River construction. However, the largest traffic shifts projected by the model are related to the Longfellow Bridge Phase II reconstruction activities and impact the Craigie Dam, Leverett Circle and other adjacent intersection along O'Brien Highway. Subsequent analyses should be completed to evaluate the potential impacts related to this anticipated traffic diversion regardless of other project schedules or sequencing considerations. This is also true for the outbound restriction only and the more restrictive Longfellow Bridge Phase II construction stages that follow.

If it is determined that the Anderson/Western/River bridges' construction periods are not preferred or able to be concurrent, it would be advantageous to have the Western Avenue/River Street Bridge construction periods coincide with the City of Cambridge's Western Avenue Sewer Reconstruction project. This could come as a result of design or procurement delays, or as a result of impacts of other non-ABP area projects that are not established at this time.

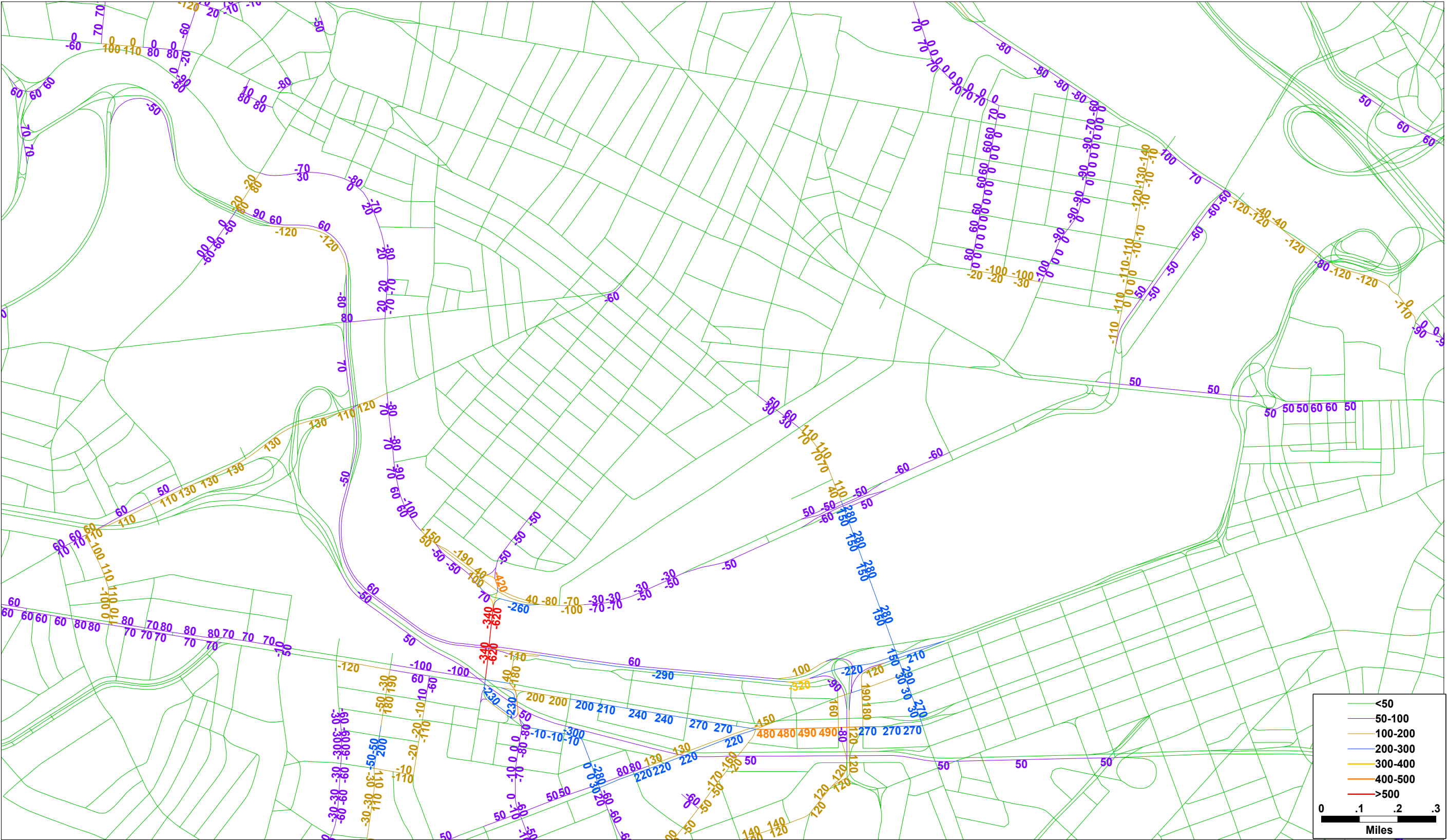
The concern over the Longfellow Bridge Phase II construction and the Craigie Draw Bridge relationship, from a traffic perspective during construction, is also being evaluated separately. The current Craigie Dam TMP is being reevaluated and a potential 'soft closure' of the Longfellow Bridge outbound movement is being analyzed by VHB and planned for later in 2010.

The results and conclusions presented in this memo are based on the preliminary evaluation of potential traffic shifts related to alternate construction sequencing from the Charles River Basin travel demand model. It should be noted that numerous assumptions were made with regard to schedule, TMPs and other non-ABP projects that could, and most likely will change. The results and conclusions provided herein could be significantly modified if assumptions were found to change. Further, it is recommended that VHB further evaluate potential sequencing impacts on an intersection by intersection basis to confirm conclusions and provide details as to additional necessary mitigation measures.



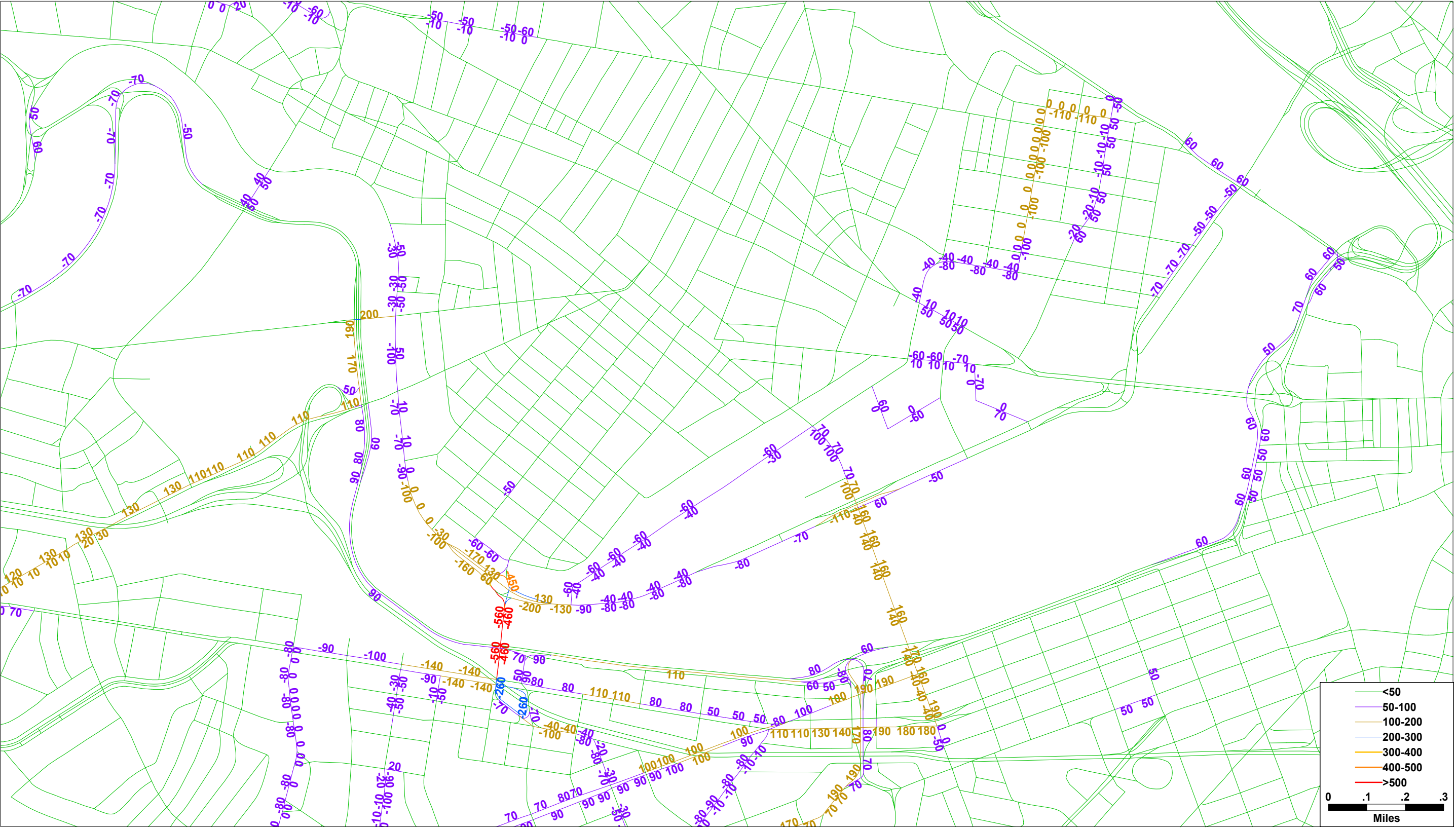
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Figure 1
Origin Destination Areas



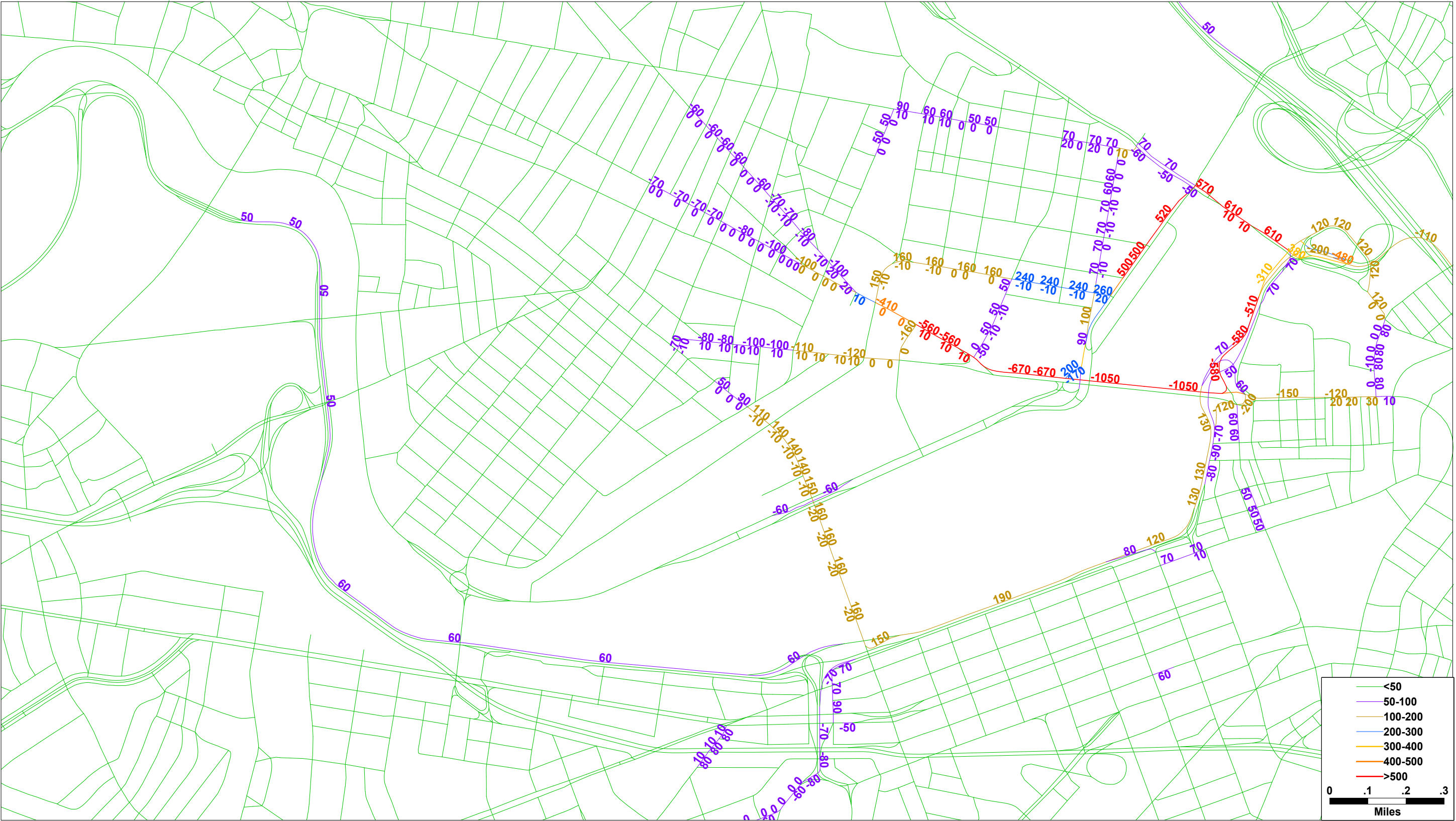
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Figure 2
Spring 2011:
Boston University and Craigie Bridges
Construction - Pre-Construction Volume
Differences - Morning Peak Hour



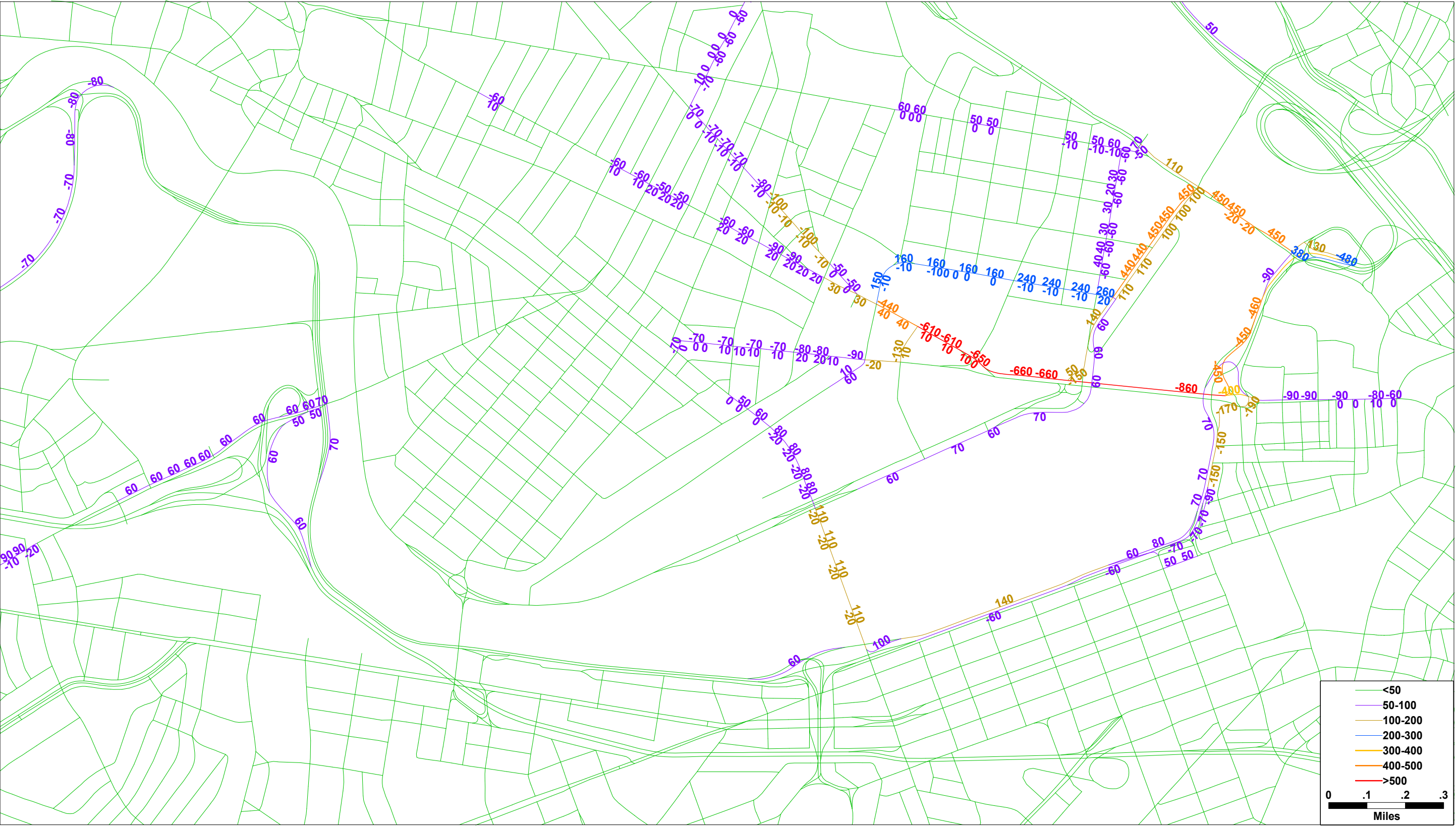
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Figure 3
Spring 2011:
Boston University and Craigie Bridges
Construction - Pre-Construction Volume
Differences - Evening Peak Hour



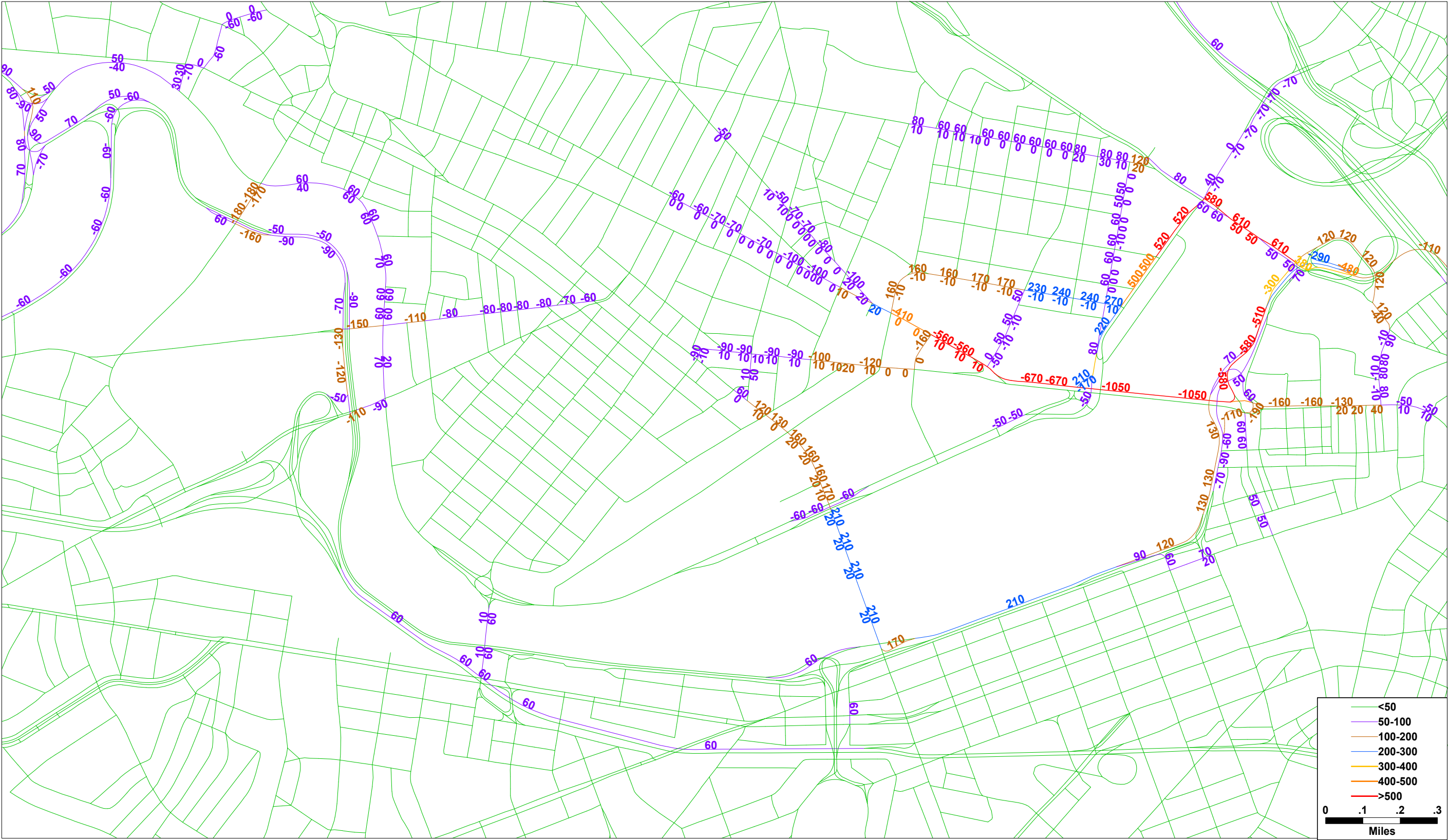
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Figure 4
Fall 2012:
Longfellow Bridge Construction -
Pre-Construction Volume Differences -
Morning Peak Hour



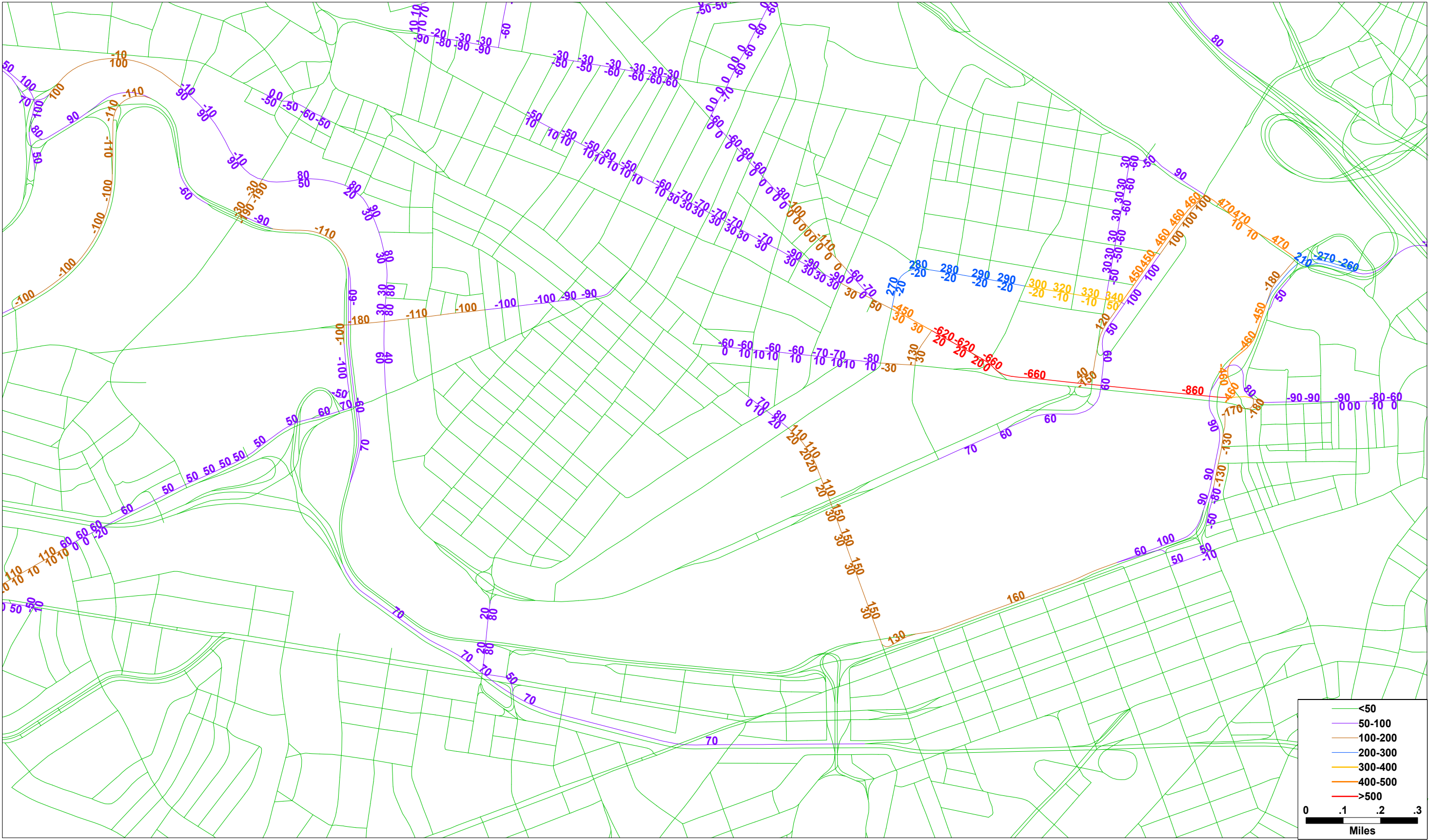
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Figure 5
Fall 2012:
Longfellow Bridge Construction -
Pre-Construction Volume Differences -
Evening Peak Hour



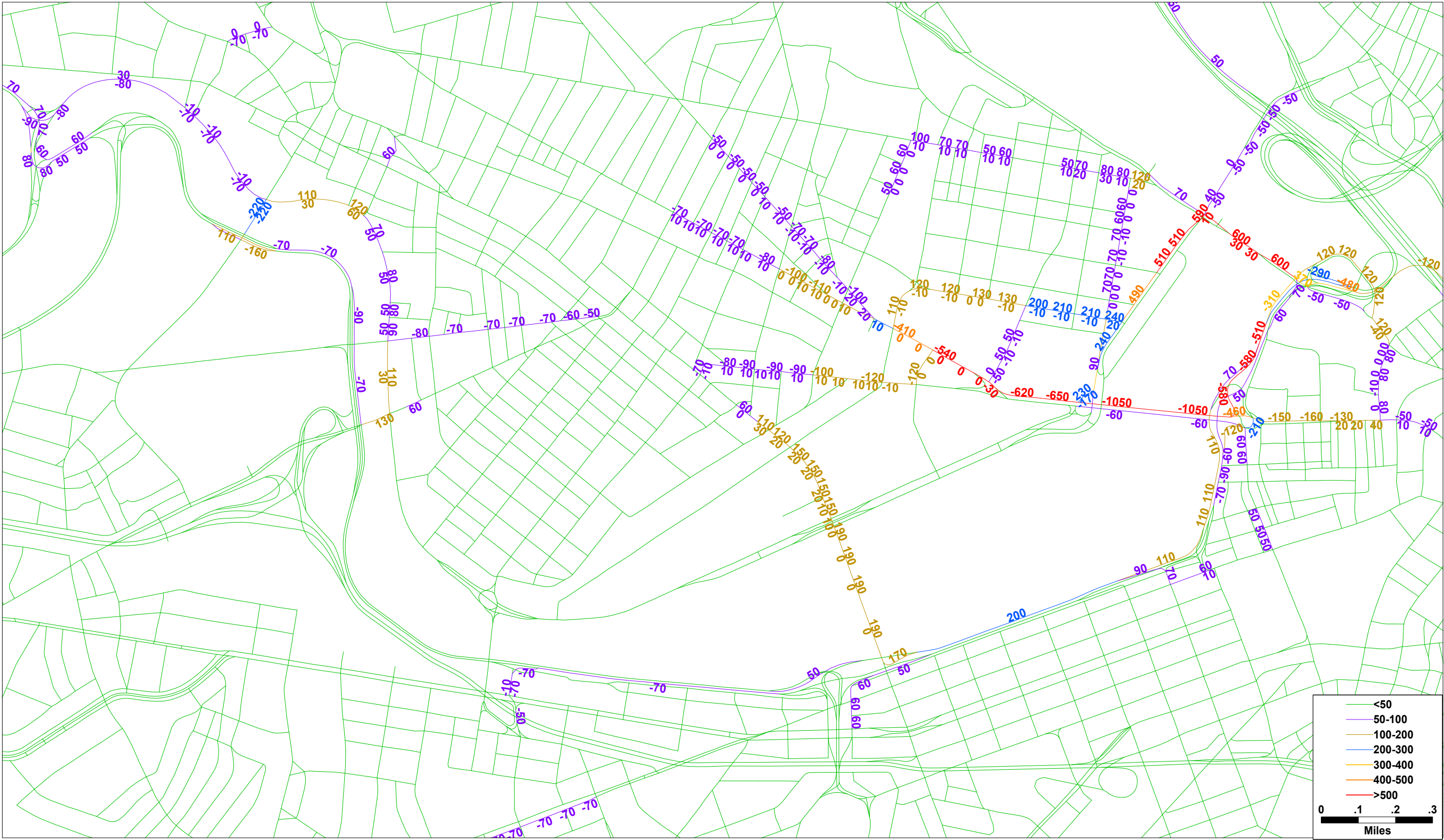
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Figure 6
Fall 2012:
Longfellow, Anderson, Western Avenue and River
Street Bridges Construction - Pre-Construction
Volume Differences - Morning Peak Hour



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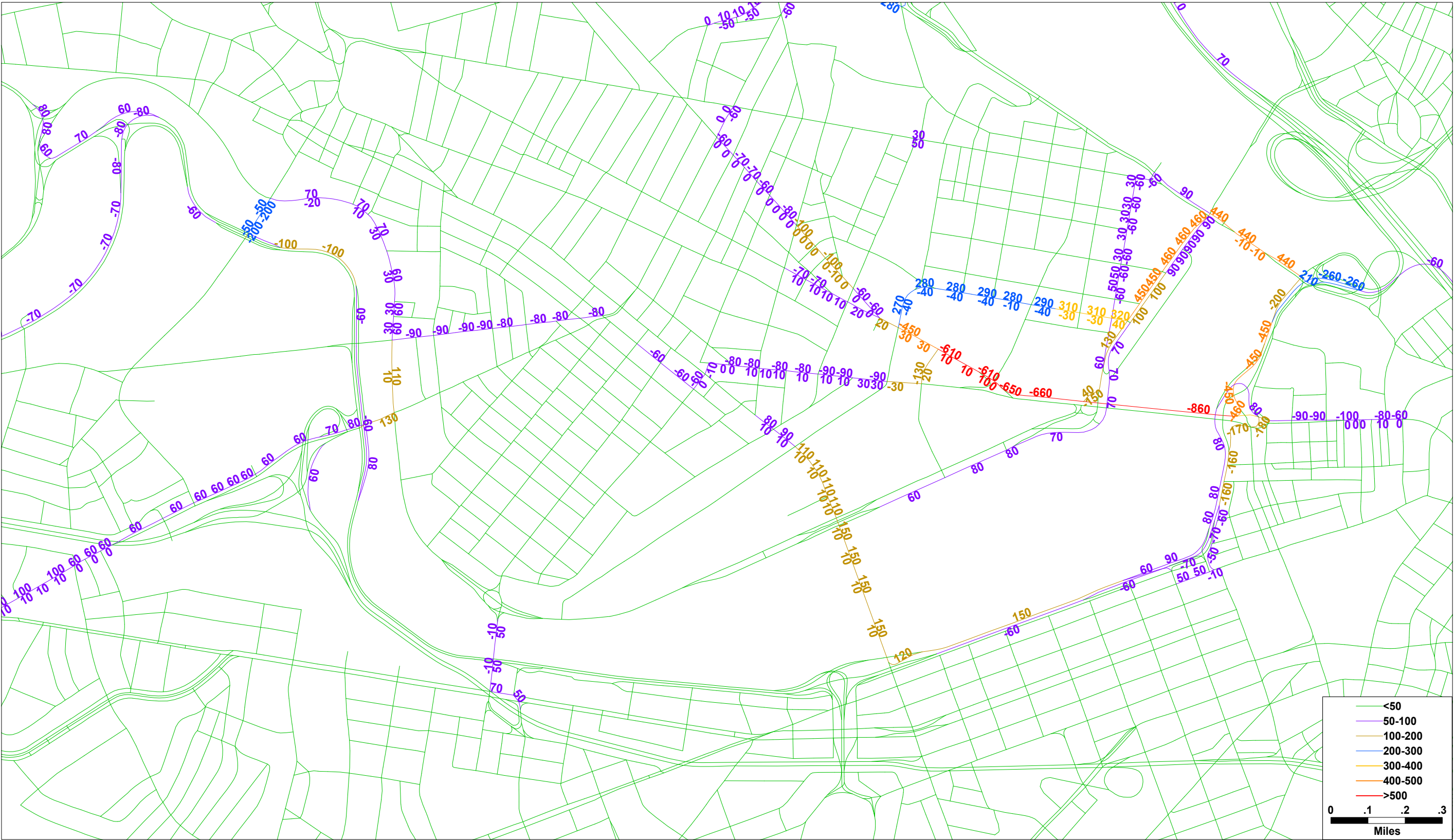
Figure 7
Fall 2012:
Longfellow, Anderson, Western Avenue and River
Street Bridges Construction - Pre-Construction
Volume Differences - Evening Peak Hour



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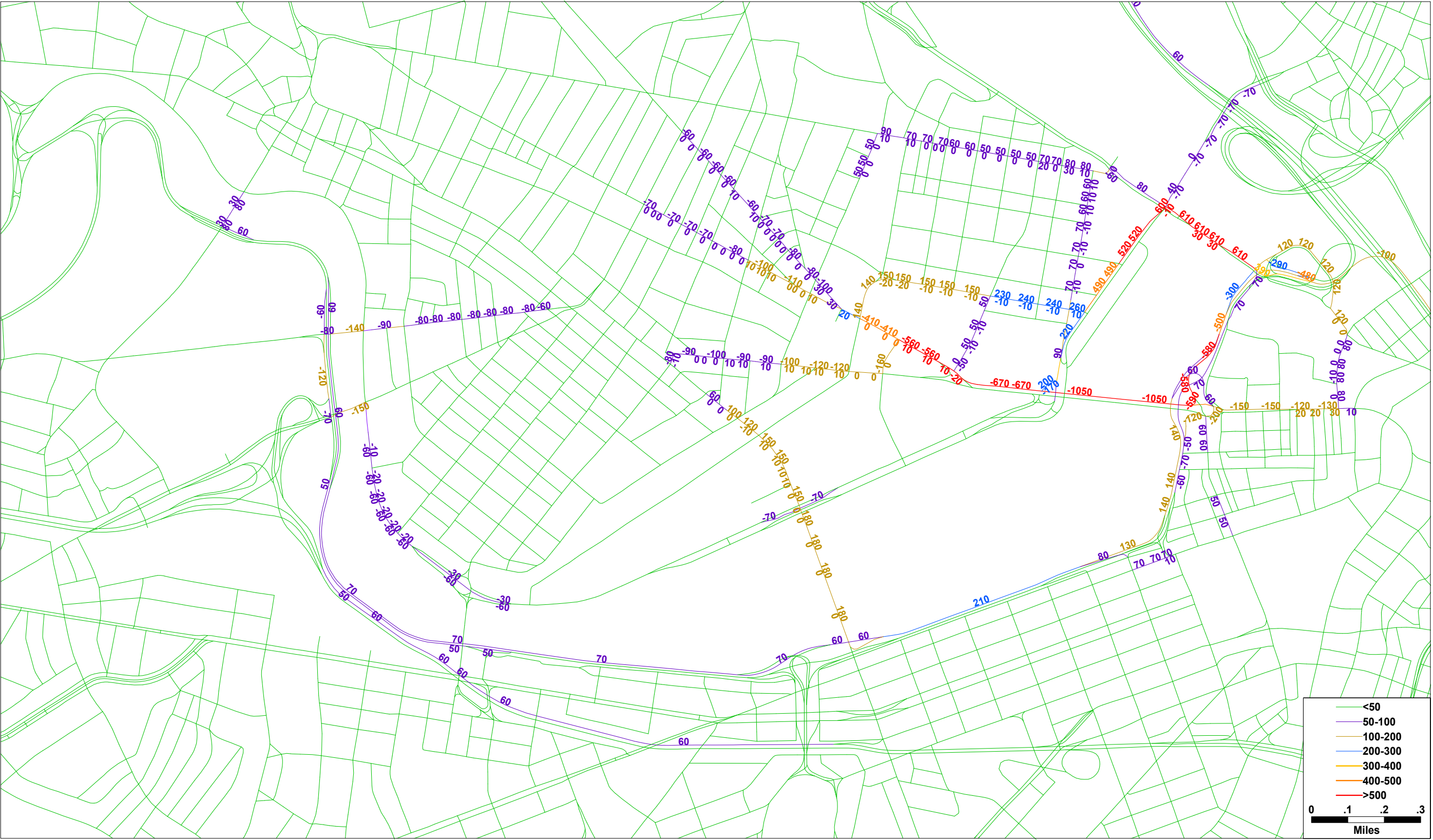
Figure 8

Fall 2012:
Longfellow and Anderson Bridges Construction-
Pre-Construction Volume Differences -
Morning Peak Hour



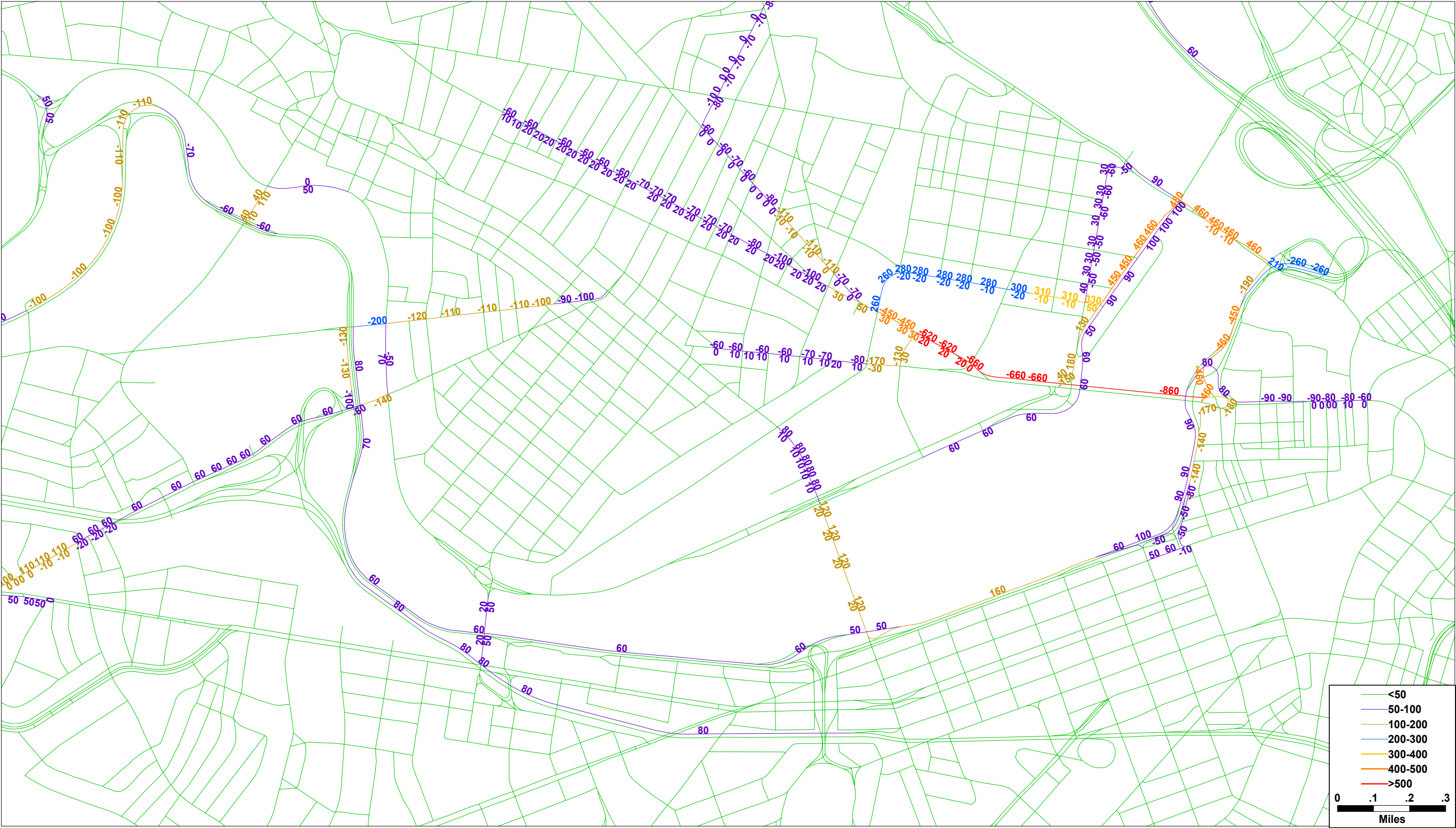
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Figure 9
Fall 2012:
Longfellow and Anderson Bridges Construction-
Pre-Construction Volume Differences -
Evening Peak Hour



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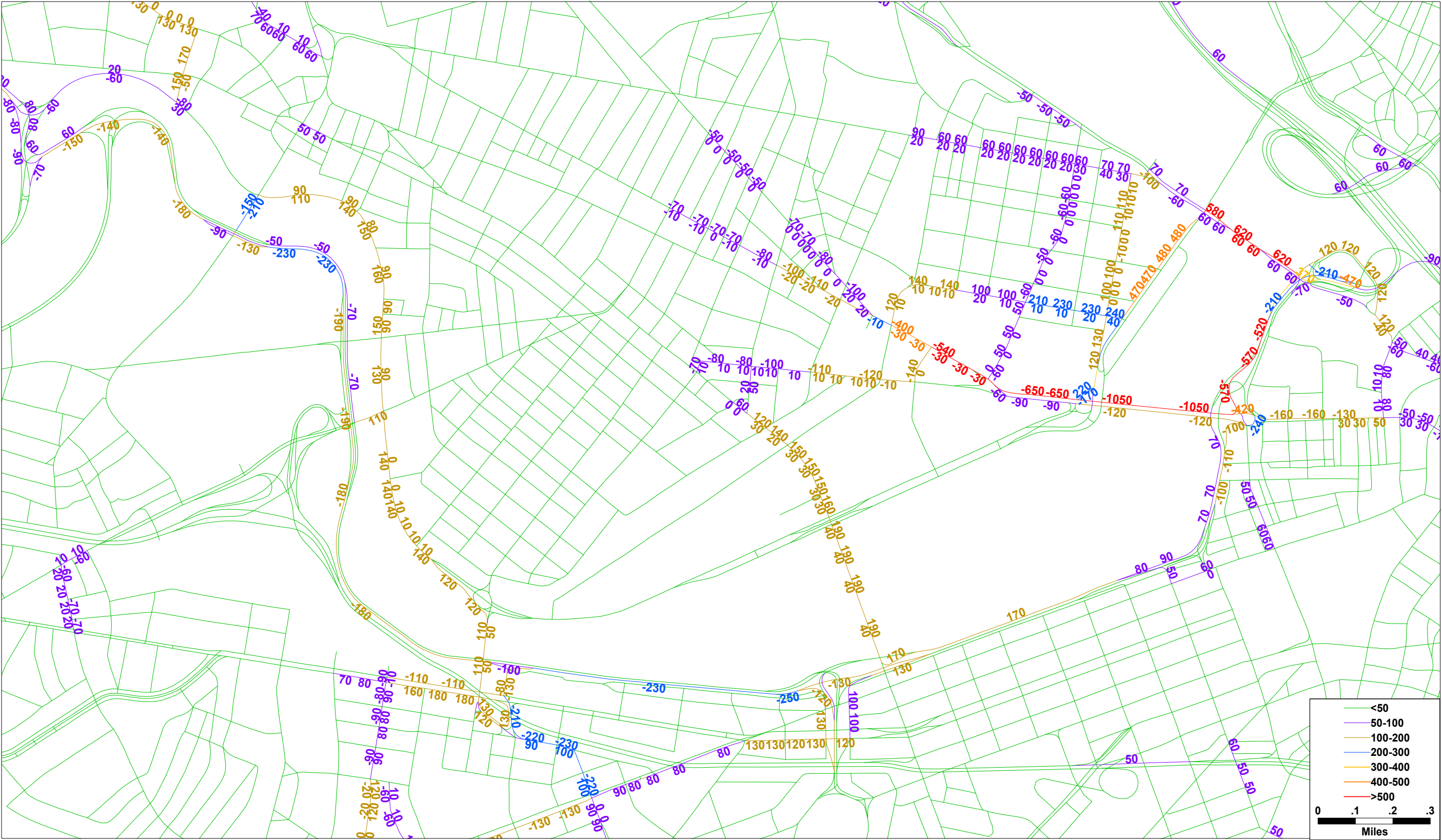
Figure 10
Fall 2012:
Longfellow, Western Avenue and River Street
Bridges Construction - Pre-Construction Volume
Differences - Morning Peak Hour



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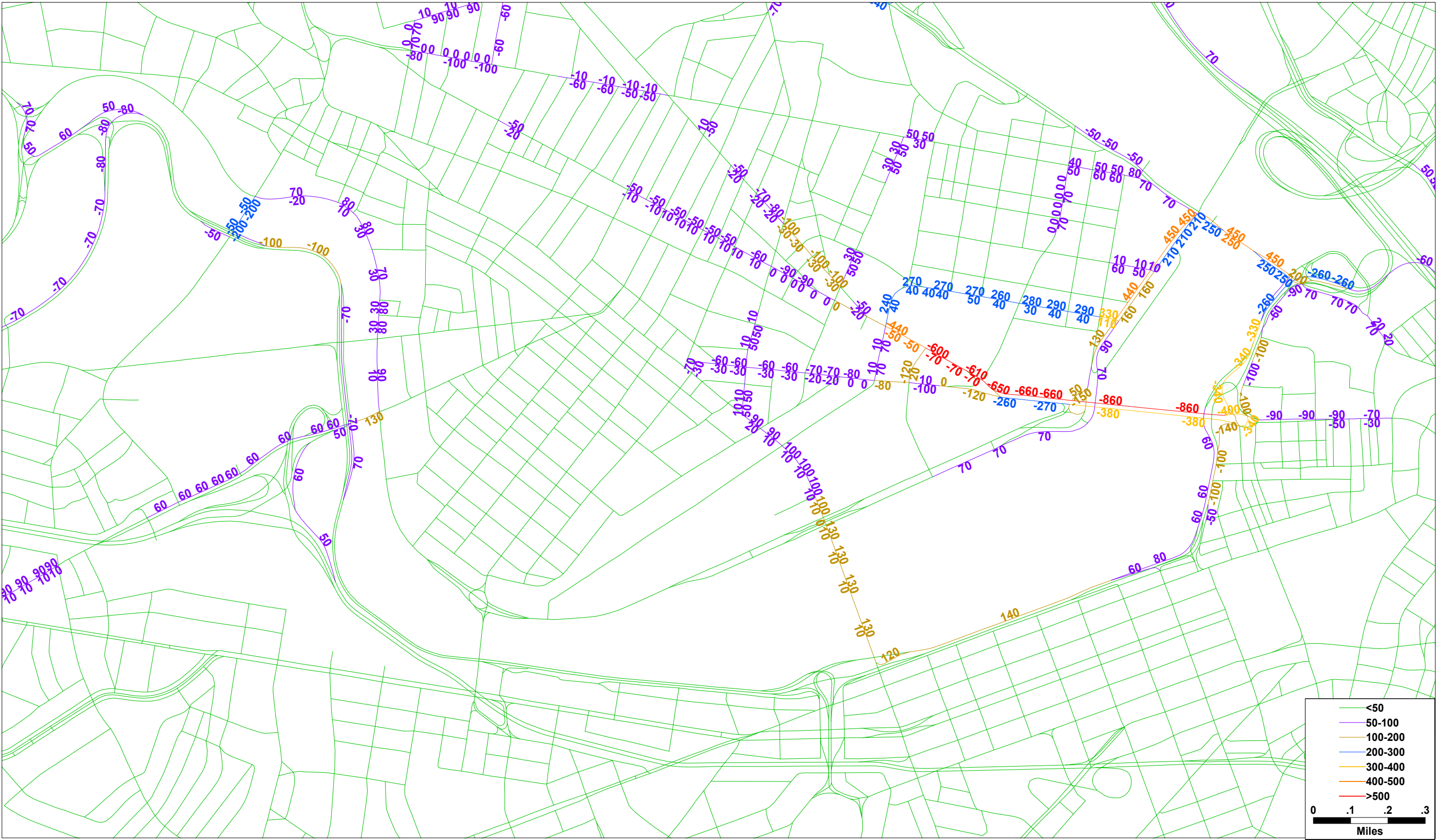
Figure 11

Fall 2012:
Longfellow, Western Avenue and River Street
Bridges Construction - Pre-Construction Volume
Differences - Evening Peak Hour



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Figure 12
Fall 2014:
Longfellow and Anderson Bridges Construction-
Pre-Construction Volume Differences -
Morning Peak Hour



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Figure 13
Fall 2014:
Longfellow and Anderson Bridges Construction-
Pre-Construction Volume Differences -
Evening Peak Hour